In *S. oblata Giraldii* there are apparently 24 paired chromosomes at diakinesis but only 23 could be counted at the telophase of the first reduction division (fig. 6). In no case were lagging chromosomes observed. Only 23 pairs of chromosomes were found in *S. Meyeri*. The chromosomes at first telophase are shown in figure 7. There are 24 pairs of chromosomes in *S. Palibiniana* at the first metaphase as shown in figure 8. There are 23 pairs of chromosomes at first metaphase in *S. velutina* (fig. 14) and in *S. Koehneana* (fig. 12). According to Rehder, *Koehneana* should be classed under *velutina*.

No counts were obtained from *S. microphylla* but the size of the pollen grain is the same as the other pure Vulgares species so that it presumably has 23 or 24 chromosomes.

All of the above species have been found growing spontaneously in Asia or southeastern Europe. *Syringa persica*, however, is usually found only as a cultivated plant and these forms are sterile; Meyer found a form of *persica* which is fertile growing wild in Kansu province, China. This spontaneous plant is similar to the cultivated variety *laciniata*. *Syringa persica* and its varieties *alba* and *laciniata* have sterile pollen and the chromosome behavior is very irregular in the reduction divisions. Unfortunately no chromosome counts were made of the spontaneous form but it has apparently normal pollen and the pollen grain size indicates that the chromosome number is the same as in the species already described.

In *S. persica* there are about 36 chromosomes at diakinesis as shown in figure 9. Similar counts were also obtained in the varieties *alba* and *laciniata*. At the heterotypic division there is usually no pairing of chromosomes and the single chromosomes apparently pass at random to one pole or the other. Such a stage in *S. persica* is shown in figure 10. In a number of cases where the division was almost completed approximately 18 chromosomes could be counted at either pole although in some cases the number varied considerably. In one pollen mother cell there were about 36–39 single chromosomes at metaphase, but occasionally several paired chromosomes could be seen. In *S. persica laciniata* about 44 chromosomes were counted in one cell (fig. 11), but usually the counts were the same as in the other two forms of the species. In the second division there are often from one to three lagging chromosomes but these were usually split. At times all of the chromosomes at the second division seem to be combined in one division figures and diads are found instead of tetrads. When tetrads are formed they usually show some irregularity in the size of the microspores.

Syringa chinensis is supposed to be a hybrid between *S. persica* and *S. vulgaris*. In the variety *Saugeana* there are about 39 chromosomes at diakinesis (figure 24). At metaphase there are usually 24 to 26 chromosomes. In one case there were clearly 24 chromosomes including one large pair typical of the species of the Vulgares group (figure 27). At the heterotypic division it was found that about half of these chromosomes were paired and the other half singles. In figure 25 there are about 13 pairs and 13 singles seen in a side view of the heterotypic division. In the variety *cucullata* typical lagging chromosomes were observed and the number of bivalents and univalents is the same as found in *Saugeana*. In figure 26 the paired chromosomes are shown after they have divided and passed to the poles while the split univalents are just beginning to divide. Only a few lagging chromosomes were observed at the second division but the tetrads usually show a few lost chromosomes in the cytoplasm.

THE VILLOSAE GROUP

Syringa villosa has either 23 or 24 pairs of chromosomes but an exact count could not be obtained. Counts of *S. Josikaea* are available only from root tip material but it is clear that there are 46 somatic chromosomes (fig. 21). *S. Henryi* "*Lutèce*" is a hybrid between *villosa* and *Josikaea*. It has 23 pairs of chromosomes which behave regularly during the reduction division. The chromosomes at the late telophase of the heterotypic division are shown in figure 13.

Syringa Sweginzowii has 23 pairs of chromosomes as indicated by the figure (15) showing the chromosomes at the late telophase of the first reduction division. One plant of *S. yunnanensis* has 24 pairs of chromosomes as shown in figure 16 but in another plant about 68 somatic chromosomes were found in the root tip (fig. 20). The triploid condition of this plant may be due to somatic mutation although the chromosome count was consistent in the roots examined.

There are 23 or 24 chromosomes in *S. tomentella*. A late telophase stage is shown in figure 17. *S. Komarowi* has 23 pairs of chromosomes which are represented at metaphase in figure 18. Only somatic counts are available for *S. Wolfii* but there are apparently 46 somatic chromosomes in this species (fig. 19).

THE LIGUSTRINA GROUP

The species of the subgenus Ligustrina have the same chromosome number as the other pure species of the genus. Both *S. amurensis* and *S. japonica* have 23 or 24 pairs of chromosomes. The chromosomes at late telophase are shown in figures 22 and 23. No counts were obtained of *S. pekinensis*, but they are very probably the same as the other two species in this group of lilacs.

In all of the species examined with the exception of *S. persica* and *S. chinensis* the pollen grains appeared to be perfectly normal. The size of the pollen grains were the same in all of the pure species.

DISCUSSION

So far as chromosome number is concerned there is apparently no reason why crosses can not be made between species in different groups or subgenera of *Syringa*. Although numerous attempts have been made to cross species of the Villosae group with those of the Vulgares group no hybrids have ever been produced. There is no record in Mrs. McKelvey's monograph concerning hybrids between the subgenera of *Syringa*. Crosses were made this year between *S. reflexa* and *S. amurensis* which have produced seeds, but it is too early to know whether the seeds are viable or if a hybrid has been produced. It may also be possible to cross species of the Ligustrina subgenus with species of *Ligustrum*. They are taxonomically very similar except in fruit characters and the chromosome number of all species of *Ligustrum* investigated is the same as found in the pure Lilac species. Crosses have been made between these two genera by Henry but no hybrids were obtained. Crosses between *Syringa* and the related genus *Forsythia* have also been made but did not produce seed. It is very improbable that this cross can be made because all Forsythia species examined have 28 somatic chromosomes.

Syringa pubescens has never been known to set seed in the Arnold Arboretum, although its chromosome behavior is regular and it forms apparently perfect pollen. Only a small amount of seed was set on *S. pinnatifolia*. It is unfortunate that these two species are so unfruitful here since they are among the most valuable for breeding work. Both species were crossed with all other species in the Villosae and Vulgares groups but few seeds were set. These species are not self sterile because single plants set seed in other localities, but the sterility here is probably due to physiological causes. They are both fertile in their native habitat and in cultivation in other localities. All of the other species are fertile and usually set seed in the Arboretum. Most Lilac species seem to be self fertile although *S. oblata* is said to be self sterile.

The chromosome behavior in *S. chinensis*, where there are approximately 12 paired and 12 single chromosomes, suggests that 12 is the fundamental number in the genus. This view is also supported by the fact that there are about 36 chromosomes in *S. persica*. In the Vulgares varieties there may be either 23 or 24 pairs of chromosomes or varieties may have 23 pairs and on univalent. Apparently the species and varieties with 23 bivalents have originated through the loss of a pair of chromosomes in a tetraploid parent. This variation is chromosome number is not limited to any one group in the genus.

Syringa chinensis (also known as *S. rothomagensis*) is believed to be a natural hybrid between *S. persica laciniata* and *S. vulgaris*. It was first obtained in 1777 by Varin, director of the Botanical Garden at Rouen, from seeds of *persica*. These seeds always produced the *chinensis* type. Varin believed that *chinensis* was a variety of *persica* but Henry in 1900 (2) and Lemoine in 1900 (3) described crosses between *persica* and *vulgaris* which produced *chinensis*.

The variety *Saugeana* originated in Varin's cultures. The Arboretum plant was obtained from Spaeth's nursery in 1900. *S. chinensis* is usually completely sterile although seeds have been reported on this species and

30 seeds grown at the Forestry Institute in Italy are reported to have produced plants of the *chinensis* type. This species has never set seed in the Arboretum.

If *S. chinensis* is a hybrid of *persica* and *vulgaris* the *persica* parent must have contributed about 12 chromosomes since there are approximately 12 bivalents and 12 univalents in chinensis.

Syringa persica laciniata in the Arnold Arboretum has 36–39 univalents and produces sterile pollen. According to Mrs. McKelvey this plant (no. 1036–2) has flowers identical in color with those of *S. persica*. She believes that it was grown from a cutting of *persica* with a preponderance of laciniate leaves. It was propagated from cuttings received from Hooper Bros. Pennsylvania in 1905. The cytological work tends to confirm Mrs. McKelvey's opinion.

The spontaneous *S. persica laciata* is represented in the Arnold Arboretum by plant number 18,537 from the U. S. Dept. of Agriculture and originally from seed sent from China. Unfortunately no chromosome counts were obtained from this plant but it has perfect pollen and the pollen grain size suggests that there should be about 24 pairs of chromosomes although judging from the counts in *S. chinensis*, it should have about 12 pairs of chromosomes.

Syringa persica and the variety *alba* are undoubtedly hybrids. They usually have 36 single chromosomes which behave irregularly at reduction and the pollen is sterile. In some cases there are a few paired chromosomes and in these cases the chromosome behavior resembles that found in *chinensis*. Henry (2) believes that *S. persica* is a hybrid between *S. persica laciniata* and *S. vulgaris*. The cytological work supports this opinion since the chromosome number is about the same as in *S. chinensis* and in some cases the behavior at reduction is very similar. Perhaps different forms of the parental species would account for the taxonomic differences found between *chinensis* and *persica*.

The variety *laciniata* is certainly the only pure species in the *persica* group and it is the only one which has been found growing spontaneously. This form was introduced from Persia into southeastern Europe where it apparently crossed spontaneously with the native *vulgaris* and produced the hybrid forms, *persica* and *persica alba*. If the hybrid forms of persica originated in this way they should be classed as varieties of *S. chinensis*. The variety *laciniata* should be considered as the only true type of *persica*.

The chromosome behavior in the *persica* hybrids also indicates that the variety *laciniata* has 12 pairs of chromosomes, although the rare occurrence of pollen mother cells with as many as 44 chromosomes at the first reduction division may call for some other explanation of the chromosome complex.

The cytological work indicates the reason for sterility in *Syringa persica* and *S. chinensis*. The variety of *persica* introduced from China by Meyer is the only one which might be of value for breeding work, since it is the only one with good pollen. However, numerous crosses were made with this form both as the seed and pollen parent but no seeds were obtained. The plant set no seeds in the Arboretum this year. In China it produces seed since it occurs spontaneously and seeds have been collected there, and in some years it produces seed in the Arboretum.

SUMMARY

Most of the pure species of *Syringa* have either 23 or 24 pairs of chromosomes. In several *vulgaris* varieties there are 23 bivalents and 1 univalent. Apparently the species and varieties with 23 bivalents have lost a pair of chromosomes.

Syringa chinensis, which is a hybrid between *S. persica laciniata* and *S. vulgaris*, has about 12 paired and 12 single chromosomes at the first reduction division although the chromosome number and the amount of pairing is somewhat variable.

Syringa persica and the variety *alba* are undoubtedly hybrids. The chromosome number and behavior is similar to that found in *S. chinensis* and it seems probable that these forms of *persica* have also been derived from crosses of *S. persica laciniata* × *S. vulgaris*. *Syringa persica laciniata* is the only pure species of the *persica* group. The chromosome counts in the hybrids indicate that the *laciniata* parent contributed 12 chromosomes to the F_1 hybrids.

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DESCRIPTION OF PLATE

All figures of reduction divisions made from permanent smears except figure 18 which is from an aceto-carmine preparation. Magnification about 2500 ×.

Fig. 1. Syringa vulgaris "Beranger." First metaphase with 24 pairs of chromosomes.

Fig. 2. S. vulgaris "Dr. Nobbe." Telophase with one univalent lagging chromosome.

Fig. 3. Same variety with 23 chromosomes at one pole in early telophase.

Fig. 4. S. pinnatifolia. 24 chromosomes at metaphase.

Fig. 5. S. pubescens. 24 chromosomes at metaphase.

Fig. 6. S. oblata Giraldii. 23 chromosomes at telophase of first division.

Fig. 7. S. Meyeri. 23 chromosomes at telophase.

Fig. 8. S. Palibiniana. 24 chromosomes at metaphase.

Fig. 9. S. persica. Diakinesis.

Fig. 10. S. persica alba. Irregular division of univalents.

Fig. 11. S. persica laciniata?. Metaphase.

Fig. 12. S. Koehneana. 23 chromosomes at metaphase.
Fig. 13. S. Henryi "Lutèce." 23 chromosomes at telophase.
Fig. 14. S. velutina. 23 chromosomes at metaphase.
Fig. 15. S. Sweginzowii. 23 chromosomes at telophase.
Fig. 16. S. yunnanensis. 24 chromosomes at metaphase.
Fig. 17. S. tomentella. 24 chromosomes at metaphase.
Fig. 18. S. Komarowi. 23 chromosomes at metaphase.
Fig. 19. S. Wolfii. 46 somatic chromosomes.
Fig. 20. S. yunnanensis. 68 somatic chromosomes.
Fig. 21. S. Josikaea. 46 somatic chromosomes.
Fig. 22. S. amurensis. 24 chromosomes at telophase.
Fig. 23. S. japonica. 23 chromosomes at diakinesis.
Fig. 24. S. chinensis Saugeana. 39 chromosomes at diakinesis.
Fig. 25. S. chinensis Saugeana. Bivalents and univalents at first reduction.
Fig. 26. S. chinensis cucullata. The 13 bivalents have divided. The univalents are beginning to divide.
Fig. 27. S. chinensis Saugeana. 24 chromosomes at metaphase. Presumably half of these are univalents.

CHROMOSOME NUMBER IN THE GENUS FORSYTHIA

JOSEPH O'MARA

THERE are, according to Rehder (1) six species of *Forsythia*. They are *suspensa, intermedia, viridissima, europaea, ovata* and *S. Giraldii* which is not in cultivation. The chromosomes of the five species in cultivation and their varieties were counted to determine if there was any relation between the chromosome number in *Forsythia* and the number in the closely related genera, *Syringa* and *Ligustrum*. It would also be of interest to know if the *Forsythia* species were inter-fertile, since a hybrid with the flowers of *intermedia spectabilis* and the hardiness of *ovata* would be of no little ornamental value.

The chromosomes could be counted satisfactorily by use of the iron-aceto carmine method described by Belling (2). The chromosomes were counted at the heterotypic metaphase and in some cases at the homotypic telophase.

The following counts were obtained:

Forsythia suspensa	14
var. Sieboldii	14
var. Fortunei	14
var. decipiens	14
var. pallida	14
var. atrocaulis	14
var. pubescens	14
Forsythia intermedia	14
var. vitellina	14
var. primulina	14
var. spectabilis	14
var. densiflora	14
Forsythia viridissima	14
var. koreana	14
Forsythia europaea	14
Forsythia ovata	14

In *Forsythia intermedia*, a hybrid between *F. suspensa* and *F. viridissima*, each parent contributed fourteen gametic chromosomes. These fourteen chromosomes proved to be perfectly compatible and no lagging was observed at either the heterotypic or homotypic divisions.

Since the gametic chromosome number in *Syringa* and *Ligustrum* is usually twenty-four it is obvious that the relation between the genus *Forsythia* and the genera *Ligustrum* and *Syringa* is a rather distant one.

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THE WOODY PLANTS OF SIGUATEPEQUE, HONDURAS

Paul C. Standley

During the winter of 1927–28 I was engaged in botanical exploration of the northern or Atlantic coast of Honduras, as the result of a coöperative agreement between the U. S. National Museum and the Arnold Arboretum, with the assistance of the United Fruit Company. Most of the season was devoted to an investigation of the flora of Lancetilla Valley, near Tela, in the Department of Atlántida, but toward the end of the winter a short collecting trip was made to the interior of Honduras.

Because of the limited time available for the visit, it was necessary to confine collections to a rather thorough exploration of a single locality, the vicinity of Siguatepeque, a small town in the Department of Comayagua, but a trip was made by automobile to the capital, Tegucigalpa, and it was thus possible to obtain a representative cross section of the vegetation of almost the whole extent of Honduras. This cross section does not show the variety that exists in a similar section across Guatemala or Costa Rica, but it does present many points of interest, and is rather typical of the vegetation of any given line drawn across Central America above Nicaragua.

The trip to Siguatepeque, despite the customary difficulties of transportation in this part of Honduras, was made in almost record time. It could have been made by the airplanes operated to the interior by the Tela Railroad Company, but airplane travel does not permit the attention to detail that is desirable in the case of systematic botanists, and it was deemed preferable to pursue the more prosaic but more practical and usual transportation routes. With the coöperation of the courteous officials of the Tela Railroad Company it was possible to make the whole trip to Siguatepeque in one day, a rather prolonged and hurried one, it is true, but still a single day.

Leaving Tela at three on a chilly moonlit February morning, in an already familiar motor car, a Ford which ran on the tracks of the banana railroad, we rode rapidly through the heavy wet tropical forest and banana plantations, the latter, as always, silvered by the moonlight, and past swamps enveloped in fog, above which the Cohune and Royal Palms projected unsubstantially. Through more bananas we passed, then along the broad, sluggish, brown Ulua River, and finally, as day was breaking, reached the inland town of Progreso.

Here our baggage was transferred to an automobile, and we rode with it to the banks of the Ulua. The stream we crossed on a flat-bottomed ferry boat, propelled by ropes and current. On the other bank we took a train, operated by a different banana company, and rode through still more fields of bananas, past plantations of light green sugar cane, and across pasture land whose trees were cut long ago.

The country on the west bank of the Ulua is much drier than the Tela region. There appear here such trees as the Guanacaste or Ear-tree (*Enterolobium cyclocarpum*), Castaño (*Sterculia apetala*), *Cochlospermum vitifolium*, with its brilliant flowers like yellow roses, and the Coyol Palm (*Acrocomia mexicana*).

Soon after leaving the river we neared the high hills, which from here southward are clothed chiefly with Pines. It is probable that the Pines on the hills nearest the coast are Cuban Pine (*Pinus caribaea*), but those farther inland are mostly *P. oocarpa*.

The distribution of Pines in Central America deserves further and careful study. The genus ranges southward into Nicaragua, but does not reach Costa Rica, although Pines often are planted about fincas in the mountains of the latter country. In some places along the Atlantic coast of Central America, as in British Honduras, and in Nicaragua, near Cape Gracias a Dios, Pine trees come to the edge of the sea, and rise high above the rocks which jut into the ocean. In other places, as here in Honduras, they do not approach within fifty miles of salt water. Probably the distribution is explainable by soil conditions, for manifestly Pines will not grow in swamp lands, such as those in which bananas thrive.

As we went farther inland, toward the foothills, the evidently drier country recalled somewhat the plains along the Pacific coast in Guatemala and Salvador. At noon we reached the railroad terminal at Potrerillos, and after a brief lunch we were off again in a *camión*, a truck fitted out as a bus.

I have seen many atrocious roads in Central America, and some of the same sort in the United States, but never have I seen one so bad as this over which it was considered possible to operate automobiles. For mules it was passable, but for motor cars it was a problem. The road was a long succession—about thirty miles—of rock ledges, mud holes of uncertain depth, and streams to be forded, all of which at first were entertaining because of their novelty and variety, but they were repeated so persistently that they soon became merely monotonous and exasperating. I am told that automobiles never fail to make the run from Potrerillos, but that sometimes it requires three days to cover the